Annual World Bank Conference on Land and Poverty 2013

DATA IS THE NEW CURRENCY IN THE LOCATION REVOLUTION – WHO WILL SUPPLY THE DATA?

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Paper prepared for presentation at the
"ANNUAL WORLD BANK CONFERENCE ON LAND AND POVERTY"
The World Bank - Washington DC, April 8-11, 2013

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KEY WORDS: geospatial data, crowdsourcing, volunteered geographic information, location based services, drivers of change, geospatial information services, authoritative data, public sector information.

ABSTRACT

A location revolution is increasingly reshaping how we use locational intelligence in our private and professional lives. The global market for Location Based Services is projected to reach over US$21 billion in annual revenue by 2015, registering around 1.24 billion subscribers. The market is being driven by the proliferation of GNSS-enabled smart phones, growing popularity of mobile commerce, and increasing usage of location based social network services, location based shopping applications, location enabled search, and location based mobile advertising. A recent McKinsey report estimates that in 2020 the worldwide personal geospatial data market will generate over US$100B in revenues for the service providers and generate US$700B of value to end users by 2020; data is the new currency. But where will these data come from?

This paper reviews how the geospatial information landscape is being transformed by a series of disruptive drivers of change and details the responses expected from the public sector, private sector and the citizen to provide geospatial data to support this location revolution. The eventual outcome of this change process is discussed through the presentation of a number of alternative future scenarios.

1. INTRODUCTION

Until recently our interest in geography and locations was probably limited to paper maps. This has changed dramatically as electronic versions of mapping pervade our TVs, games, local government websites and our smart phones. A new generation of Internet products, such as Google Earth and Bing Maps, for example, are stimulating a greater interest and use of geography in society. We are much more location aware and Location Based Services (LBS) are reshaping how we plan trips, meet friends and find good local restaurants. Web 2.0 social media has become location-based and has moved social media from cyberspace to real place (Sui and Goodchild, 2011). Most location-based social media allow users to

know and see on a map where their friends are physically located at a particular time, primarily based on GNSS-enabled, mapping-equipped mobile phones.

The global market for LBS is projected to reach over US$21 billion in annual revenue by 2015, registering around 1.24 billion subscribers (PRWeb, 2012). The market is being driven by the proliferation of GNSS-enabled smart phones, growing popularity of mobile commerce, and increasing usage of location based social network services, location based shopping applications, location enabled search, and location based mobile advertising. Additionally, increasing demand for personal navigation and LBS that provide users with Points of Interest (POI) information augurs well for the future of this market and the associated geospatial data market.

This location revolution in our personal lives is being mirrored in our professional lives. Geospatial information is increasingly being used to ensure emergency services arrive at incidents in time, to support the formulation of policies to mitigate the impact of climate change, to ensure that services are better targeted to citizens needs and to empower citizens and communities to manage their localities more effectively.

The delivery of the benefits associated with this location revolution is dependent on the availability of geospatial data that is readily accessible for re-use, has minimal restrictions, is affordable, has an appropriate quality and can be easily integrated and linked into collaborative environments using standards from the Open Geospatial Consortium (OGC) and the International Organisation of Standardisation (ISO) and techniques like linked data (http://linkeddata.org) – used for exposing, sharing, and connecting pieces of data, information and knowledge on the semantic web. A recent McKinsey report (McKinsey, 2011) estimates that in 2020 the worldwide personal geospatial data market will generate over US$100B in revenues for the service providers and generate US$700B of value to end users by 2020; data is the new currency.

This paper reviews how the geospatial information landscape is being transformed by a series of disruptive drivers of change and details the responses expected from the public sector, private sector and the citizen to provide geospatial data to support this location revolution. The eventual outcome of this change process is discussed through the presentation of a number of alternative future scenarios.

2. DRIVERS OF CHANGE

Geospatial information services are positioned within a turbulent landscape that is being shaped by a diverse set of drivers of change, ranging from the global financial crisis through new disruptive data capture technologies to the changing role of the citizen. The most influential drivers of change impacting geospatial information services are detailed below in the following categories: political / governance / policy; economic and market; social and demographic; technological; and environmental (adapted from Kennedy & McLaren, 2013).

2.1 Political, Governance and Policy Drivers

Open government

Improved access to public sector geospatial information is also being enhanced by the increasing adoption of Open Government policies across the world. These Open Government initiatives normally have three main strands: Open Data, Open Information and Open Dialogue (FIG, 2012). The USA and the UK were the first and launched their open data initiatives in 2009. Offering government data in a more useful format enables citizens, the private sector and non-government organisations to leverage it in innovative and value-added ways. This has been justified on economic grounds (Vickery, 2011) (ACIL, 2008) since access to this data will have major benefits for citizens, businesses, and society and for the governments themselves.

National Information Framework

The public sector produces vast quantities of information, including geospatial information. The growth in information production has been incremental and ad hoc, driven by new policies and legislative requirements. There has been no strategic approach to the information collected and limited rationalisation over the years. There is therefore a need to create a contemporary National Information Framework (NIF) (APPSI, 2012) which includes (at least) all key datasets to meet currently anticipated needs in governments and other key sectors. Governments should rethink what geospatial data they should collect and manage in the future based on producing a NIF that is attuned to long term economic and social needs. The legacy of the mapping era has been the “topographic map” paradigm for capturing, modelling and presenting geospatial data. Given the now available technologies and sources of data, it is time for this underlying paradigm to be refreshed.

Finding horizontal solutions to key policy issues

Pressure will increase to produce complex modelling of integrated data for "what if" scenario development and strategic impact assessments in support of policy development, and location will be a critical element to enable visualization of different scenarios and impacts.

Overall budget restraint, government downsizing and changing priorities

Cost reduction and efficiency requirements will see more government organizations outsourcing processes to the private sector, partnering with Volunteered Geographic Information (VGI) data providers and others, and focusing on the roles of commissioning and managing the delivery of National Spatial Data Infrastructures.

Authoritative geospatial data

Challenges to the "authoritativeness" of government geospatial data, especially in high population areas, are being mounted by the proponents of crowdsourced data who claim that their data are more accurate and current. However, if geospatial data becomes more fully integrated within decision-support tools, the importance of authoritative, trusted data will become more widely recognized, and the role of government to provide such data may be more clearly understood and accepted and resources will be made available for its maintenance.

The environmental agenda

Growing public concern about environmental degradation due to increasing pollution and global climate change is driving public sector investments in new geospatial data sources, particularly from ground-based sensor webs and satellite Earth Observation (EO) sensors, e.g. the EU's Copernicus initiative – formerly the Global Monitoring for Environment and Security (GMES) initiative.

2.2 Economic and Market Drivers

Globalization

Industry consolidation is occurring with acquisitions focused on creation of vertical value chains encompassing data collection, management and applications technologies and services, e.g. Trimble, Rolta and Hexagon. If global information service providers cannot easily access data with limited restrictions on reuse, then they will source alternatives globally.

Global economic uncertainty

Governments will continue to place a priority on deficit and debt reduction, increasing the pressure on the budgets of government agencies involved in geospatial information.

Spatial not so special

Ubiquity of geospatial data means high volume use of online data, resulting in increased competition and downward pressure on prices, encouraging Geomatics companies currently focused on the data collection and processing business to move up the value chain to avoid failure.

Shifts in the roles and impacts of the private and public sectors

The traditional role of government agencies as the primary providers of geospatial data is increasingly being taken up by the private sector, which has been largely responsible for the emergence of consumer interest in and use of such data.

Business to Consumer (B2C) market growth

While the highest growth segment for geospatial information is the B2C market, with over 100 million people using web maps each month, virtually none of these data are provided by the traditional Geomatics industry players and none of them are paid for by the end user. Even if Geomatics businesses do not see a role in the B2C market, they may soon be facing competition in the business to business (B2B) market space from crossover B2C players that have developed challenging cost and business models. Increasingly, the consumer to business (C2B) market is emerging as consumer applications are finding roles within the business environment.

Satellite imagery market growth

The rapidly increasing availability of space EO imagery provides important opportunities for the Geomatics Sector to develop new applications for environmental monitoring, natural resources exploration and exploitation, land planning and development, etc.

Airborne imagery market shrinkage

As more high resolution satellite imagery with shorter repeat coverage cycles becomes more accessible at lower costs, the demand for aerial imagery will decline to a primary focus on near real-time applications. Unmanned Aerial Vehicles (UAVs) will provide an increasingly attractive alternative to aerial imagery capture from fixed wing aircraft, providing cost savings and access to areas that might be otherwise inaccessible.

2.3 Social and Demographic Drivers

Influence of the wired generation or "Generation Y"

An expectation that digital content should be available free online, and an increasing willingness to challenge the legal rights of content owners, will encourage information providers to access new delivery channels and find viable new business models.

Crowdsourcing / volunteered geographic information (VGI)

The emergence of Internet mapping sites like OpenStreetMap and Wikimapia has raised the public's interest in being active contributors to the geospatial information in their communities (the so-called "produsers"), and acts as a valuable mechanism to encourage public participation and to engage and empower citizens. As crowdsourced content continues to improve, placing pressure on government authoritative data providers to justify expensive data maintenance programs, collaboration between these two groups will improve.

Technology convergence

Mobile devices with integrated voice and data communication, camera, GNSS, compass, inclinometer, etc. will turn ordinary citizens into mobile sensors, contributing to the demand for and supply of previously unimaginable amounts of location data, including indoor location information.

Centimetre positioning in a mobile environment

A GNSS universe of some 100 plus satellites by the end of this decade, integrated with other sensor sets (typically low cost Micro-Electro-Mechanical Systems (MEMS) devices and compasses), will mean that positioning devices will work reliably in far more places than they currently do, and applications enabled by the technology will spiral upwards in terms of volume and sophistication.

Data volume growth (e.g. LiDAR, laser scanned point clouds, 10-30 cm EO data from 385 instruments by 2015, crowd-sourced data, etc.)

With estimates of daily data production as high as 2.5 quintillion bytes, much of it georeferenced, reliance on "big data" technologies, such as massively scalable, distributed systems for processing unstructured and semi-structured data, will continue to grow.

Exploitation of "big data"

Location Based Services exploiting big data have the potential to create up to $700 billion consumer surplus value, but policy makers will often need to push the deployment of big data innovations for consumers to benefit.

Increased systems complexity

Peer-to-peer sensor webs will integrate intelligent sensors, high speed data processors, high bandwidth wireless infrastructure and data base technology for real-time data synthesis and analysis applications for monitoring of air quality, water resources, disease threats, etc.; location will be a key attribute.

2.4 Environmental Drivers

Global climate change rate reduction and adaptation

The modelling of environmental phenomena such as climate change is increasingly demanding fully integrated environmental information in the land, marine and air domains that have traditionally been managed separately, and geospatial information has a key role to play in such integration efforts.

Environmental activism

Citizen concern about the deteriorating state of our environment will continue to rise, and expectations are high concerning ownership of or access entitlement to environmental information, most of which is connected to location. Crowdsourcing of data, e.g. biodiversity observations, stewardship activities, etc. by "amateur environmentalists", i.e. citizen science, will grow rapidly, most of which will be georeferenced.

Emergency response, and disaster management and recovery

Three-dimensional models of the built environment (building facilities and above ground and underground infrastructure) and 3D cadastre (for multi-owner building units like condominiums) will be needed to support faster and more effective response to emergency situations in order to reduce loss of life and property damage.

3. FUTURE SCENARIOS

Organisations and individuals tend to make decisions based on their "mental map" of the future. We can only have a partial understanding of our context, but this helps to shape our particular map of the future, influencing our assumptions about which aspects of the future are important to the choices we face (Shell, 2008). Exploring the assumptions we currently hold about the future, as individuals and collectively, can equip us to act more effectively to help shape the future. Scenarios are a foresight approach to help us recognize when our assumptions are being challenged by events and how to respond successfully.

A scenario is a story that describes a possible future. Decision-makers can use scenarios to think about and discuss the uncertain aspects of the future—or to discover the aspects about which they should be concerned—and to explore the ways in which these might unfold. There is no single answer to how the future will unfold, so sets of scenarios must be created. These scenarios all address the same important questions and all include those aspects of the future that are plausible, i.e., the predetermined elements, but each one describes a different way in which the uncertain aspects of the future could play out.
Scenarios are intended to form a basis for strategic conversation and for considering potential implications of and possible responses to different events, opportunities and challenges. They provide a means of exploring future uncertainties and making more successful decisions (Kennedy and McLaren, 2013).

This paper adopts the scenario approach to describe possible futures of the geospatial information services landscape and how the public sector, private sector and citizens may contribute. Four scenarios are presented:

A. Business as Usual
B. Citizen Centric
C. Global Domination
D. Partnerships

3.1 A. Business as Usual

This scenario assumes that the current situation, and the relationships amongst the public sector, private sector and citizens, continues with little variation.

Scenario A:

- The public sector agencies involved in delivering geospatial information services continue to convince their governments, despite austerity programs, that authoritative data is essential to underpin the planning and delivery of services and to support evidence based policy formulation. This justification secures their budgets and, although the agencies do not expand their services, they maintain a strong foothold in the authoritative data market.
- Governments increasingly adopt Open Government and Open Data policies on the evidence that this stimulates innovation, leads to economic development and increases citizen engagement in democracy. Governments in effect subsidise public sector agencies in the production and distribution of Public Sector Information (PSI), including geospatial information. However, there is no attempt to rationalise PSI and adopt a more strategic approach.
- Although some governments collaborate with the global geospatial information service players and use this opportunity as a channel to market their products, there is still a competitive standoff between the majority of these stakeholders.
- Although some of the government agencies try to compete in the consumer geospatial information services market, they are unable to compete effectively against the global geospatial information service players.
- The global information service players continue to place importance on geospatial information as an effective means of levering revenue from location based shopping, location enabled search, and location based mobile advertising applications (the importance and reputational value was clearly demonstrated when Apple tried unsuccessfully to produce a product to compete with Google Maps). Their business models, based on advertising revenues for example, continue to allow them to provide free, on-line access to the global coverage of their geospatial data that includes satellite imagery, street view video and topographic map data. They continue to dominate the consumer market and are starting to apply their consumer applications to the business market.
- In cases where global information service providers cannot easily access geospatial data with limited restrictions on reuse, they source alternatives globally. This becomes increasingly easier through access to EO data and new ground based data capture techniques, such as LiDAR.
- The involvement of citizens in expanding the availability of geospatial information services on the Web continues through crowdsourcing / VGI / citizen science. However, the scope is limited through crowdsourcing ‘fatigue’ and a lack of understanding by both the public and private sectors of how to effectively engage with this valuable source of geospatial information.

- The lack of consistent coverage and doubts over data quality limit the wider use of crowdsourced geospatial information services, such as OpenStreetMap.

Discussion:

The drivers of change highlighted in the previous section are already having a significant impact on the geospatial information services sector. These are creating considerable tensions across the sector that will inevitably trigger major changes. The major losers will most likely be public sector agencies directly involved in delivering geospatial information services. Although this scenario depicts a future where such agencies justify their continued existence, it is unlikely that this will be sustainable in the face of increasingly "authoritative" data available from other sources. To survive, these agencies need to reassess their relevance and position in the modern information landscape, devise innovative business change strategies and migrate to a new set of geospatial information services relevant to and sustainable in the 21st century.

3.2 B. Citizen Centric

This scenario assumes that there is significant expansion in the extent and role of crowdsourcing / VGI and this becomes the dominant force in supporting geospatial information services.

Scenario B:

- The public sector agencies involved in delivering geospatial information services continue to focus on the delivery of authoritative data. They do not engage effectively with the citizens that are providing crowdsourced / VGI information and follow their traditional approaches to authoritative data collection and maintenance.
- Many public sector agencies continue to charge for their authoritative data. Market share and associated revenues fall and they become increasingly isolated. Sustainability of the agencies is severely jeopardised.
- The public sector agencies are still encumbered with their legacy of the mapping era and continue with the "topographic map" paradigm for capturing, modelling and presenting geospatial data. The business and consumer markets become increasingly disenchanted with the agencies' relatively outdated products and services and their market share falls even more.
- The range of PSI released by governments remains ad hoc and does not effectively meet the on-going needs of society or business. Despite being open data, the use of PSI declines as requirements change and alternative sources are created to fill the market gap.

- Those Land Administration agencies that change their relationships with the citizen and support and formalise land rights crowdsourced by citizens are successful in expanding security of tenure.
- Citizens fully embrace crowdsourcing / VGI activities and these communities start to grow and build comprehensive, consistent and high quality geospatial information services. This is supported by accessible technologies such as mobile phones, UAVs and open source solutions, for example. Initially the focus is in urban areas, but over time this expands to take in rural areas.
- The crowdsourced / VGI geospatial information services become increasingly popular in both consumer and commercial domains and compete directly and successfully with public sector 'authoritative' geospatial data. The resulting geospatial information services are now more aligned with societal and commercial needs.
- A dense network of real-time sensors (apart from citizens as sensors) is increasingly used to directly identify and report change and to provide real-time information.
- The global information service providers benefit from these crowdsourced comprehensive, consistent and high quality geospatial information services and embed them into their location based services and geospatial search engines. Synergy and collaboration is formed between the global information service providers and the crowdsourcing communities.

Discussion:

Although crowdsourcing activities have already produced some startling results, i.e. OpenStreetMap, the quantity and persistence of citizens' input to crowdsourcing is still very low. The current issues with quality, currency, consistency and comprehensiveness of crowdsourced information limit its use in critical service applications. However, the increasing use of geospatial data sourced from location-based social media and passive crowdsourcing will increase its applicability. There may well be a tipping point when crowdsourced data comes of age and is recognized in the marketplace as being more "authoritative" than that produced by public sector agencies. This scenario could well materialise; possibly incrementally in a series of application areas.

3.3 C. Global Domination

This scenario assumes that the global information service providers will increasingly dominate, as public sector agencies fail to respond to the forces of change. Although the global information service providers may be supported to some extent by crowdsourcing and public sector agencies involved in delivering geospatial information services, these stakeholders will be subservient and the public sector agencies dedicated to geospatial information services may well disappear.

Scenario C:

- The global information service players' business models, based on advertising revenues for example, are so successful that they can afford to increase the coverage, currency and accuracy of their geospatial data and continue to provide free, on-line access to their global coverage.
- This dominance is fuelled by access to increasingly effective data capture technology and highly competitive supply chains.
- The global information service players form strong collaborations with the crowdsourcing communities to strengthen this channel of change detection and data supply, increasingly sourced through location-based social media and passive crowdsourcing, and entice these communities into their 'digital civilisations'.
- The global information service players totally dominate the consumer market and through the delivery of geospatial data that is recognized as being authoritative, they start to dominate the business market. There is no hiding for the public sector agencies involved in delivering geospatial information services.
- The public sector agencies involved in delivering geospatial information services continue to retreat and focus on the delivery of authoritative data. Since they no longer have a monopoly on authoritative geospatial data, their *raison d'etre* and revenues are quickly eroded. Many governments find it increasingly difficult to justify and fund their agencies dedicated to geospatial information services.
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Discussion:

This is probably the most likely scenario to come to fruition. We are witnessing the growth of powerful, cash rich, global enterprises that are pursuing strategies that reach far beyond the confines of existing markets. They are causing widespread market collisions as they push industries to overlap, merge or cease to exist. They are outflanking and disrupting companies that follow less ambitious corporate strategies, including the geospatial data sector. These new Digital Civilizations (Fogg, 2011) use identity to tie numerous disparate products, many devices, multiple platforms and product portfolios together into their long term strategy. Each Civilization has hundreds of millions of active users — often with credit cards attached — far more than even the largest telecom operators or media companies; Amazon has over 121 million active buyers (November 2010), Apple has over 225 million accounts with credit cards attached (June 2011) and there are over 800 million active Facebook users (November 2011). These Digital Civilisations are increasingly using geospatial data and associated services to entice users to become and

stay members. Once the global information service players have full control of global geospatial information services, there is a danger that they might change the ground rules for licensing and charging for access to their geospatial information services – just as Google recently did to high volume users of their Google Map services.

3.4 D. Partnerships

This scenario assumes that the global information service providers, public sector agencies involved in delivering geospatial information services and crowdsourcing / VGI communities collaborate effectively and each stakeholder group finds a niche where they can survive in the global geospatial information services landscape.

Scenario D:

- The public sector agencies involved in delivering geospatial information services evolve into a role of either directly providing foundation datasets / core reference geographies (Barr & Roper, 2009) or regulating / guiding other stakeholders to produce them to agreed standards. These foundation datasets / core reference geographies are provided as open data, with minimal restrictions on their re-use, and become the default reference frameworks for the geospatial data being collected from other sources, e.g. crowdsourcing and the global information service providers. This supports greater interoperability across geospatial data.
- These foundation datasets / core reference geographies are adopted by the global information service players and the crowdsourcing communities.
- The contribution of the public sector agencies is contractually formalised and there is some form of financial agreement amongst the parties, which helps to sustain the public sector agencies for the long term.
- Governments reassess their PSI and create contemporary National Information Frameworks (NIFs). This reassessment includes what geospatial data they should collect and manage in the future based on producing NIFs that are attuned to long term economic and social needs.
- The global information service players form strong collaborations with the crowdsourcing communities to strengthen this channel of change detection and data supply, increasingly sourced through location-based social media and passive crowdsourcing, and entice them into their ‘digital civilisations’.

Discussion:

The global technology companies have understood the power of location and just how effective the use of geospatial data is in generating significant revenues through location based shopping, location enabled search and location based mobile advertising applications. Where these companies cannot source existing geospatial data, they are creating their own sources with increasing levels of detail and quality. These data are being augmented by crowdsourcing, increasingly sourced through location-based social media and passive crowdsourcing. This will place further pressure on the survival of NMCAs who will retreat to the diminishing market for authoritative geospatial data. However, if the public sector agencies involved in delivering geospatial information services evolve into a role of either directly providing or regulating foundation datasets / core reference geographies then they could have a role in this partnership scenario. However, these agencies are traditionally slow to react to change and may well miss this opportunity.

4. CONCLUSIONS

The geospatial information services landscape is currently being buffeted by strong winds of change, including disruptive technology and the impact of the global financial crisis, but is increasingly being controlled and orchestrated by a small number of global technology companies that understood the power of location and just how effective the use of geospatial data is in generating significant revenues. Crowdsourcing adoption across the sector will significantly increase allowing users to tap into this valuable source of geospatial data and to ensure that geospatial information services evolve to meet users' requirements. However, the largest unknown within this future landscape is the role of the public sector agencies involved in directly delivering geospatial information services. These agencies need to reassess their relevance and position in the modern information landscape, devise innovative business change strategies and migrate to a new set of geospatial information services relevant to and sustainable in the 21st century – before it is too late.

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BIOGRAPHICAL NOTES

Robin McLaren is director of Know Edge Ltd a UK based, independent management consulting company formed in 1986. The company supports organisations to innovate and generate business benefits from their geospatial information. Robin has supported national governments in formulating National Spatial Data Infrastructure (NSDI) strategies. He led the formulation of the UK Location Strategy and has supported similar initiatives in Kenya, Hungary, Iraq, Western Australia and Canada. He has also supported the implementation of the EU INSPIRE Directive in the UK and was recently a member of the UK Location Council. Robin is also recognised as an expert in Land Information Management and has worked extensively with the United Nations, World Bank and EU on land policy / land reform programmes to strengthen security of tenure and support economic reforms in Eastern and Central Europe, Africa, Middle-East and the Far-East. His recent research focuses on the innovative use of crowdsourcing to support citizens in directly capturing their land rights.

Ed Kennedy is a Senior Associate with Hickling Arthurs Low (HAL) Corporation and Principal, Kennedy Geoinfo Consulting. Between 2003 and 2011 he was Managing Director of Canadian GeoProject Centre, a business network hub that helped to source spatial information business in target foreign markets. Mr. Kennedy's previous positions included President of the Geomatics Industry Association of Canada and Assistant Deputy Minister with Alberta Forestry, Lands and Wildlife. Ed's consulting experience spans the past 25 years. He has conducted broad industry consultations and been involved in consulting assignments for government agencies and NPOs in Canada and abroad covering spatial data infrastructure (SDI), earth observation, space science, global navigation satellite systems, automated identification systems (AIS), digital cadastre, international trade, research and innovation, agriculture, environment, and critical infrastructure. One of his specializations is SDI policy development, and he has been engaged since 2011 in the development of a range of operational policies

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